

AMENDMENTS TO THE CLAIMS

The claims in this listing will replace all prior versions, and listings, of claims in the application.

Listing of Claims

1. (Cancelled).
2. (Previously Presented) The solid-state imaging apparatus according to claim 9,
wherein incident light is collected in a center of a plane made of said plurality of light-transmitting films, the incident light being incident at an angle asymmetrical to a center of a plane made of said plurality of light-transmitting films.

3. (Previously Presented) The solid-state imaging apparatus according to claim 9,
wherein an amount of phase change of the incident light, $\phi(x)$, depends on a distance x in an in-plane direction and approximately satisfies the following equation,

$$\phi(x) = Ax^2 + Bx \sin \theta + 2m\pi$$

wherein θ is an incident angle of the incident light, A and B are predetermined constants, and m is a natural number.

4. (Previously Presented) The solid-state imaging apparatus according to claim 9,
wherein

$$\Delta n(x) = \Delta n_{\max} [\phi(x) / 2\pi + C]$$

is satisfied, where Δn_{\max} is a difference of refractive indices between one of said plurality of

light-transmitting films and a light-incoming side medium, $\Delta n(x)$ is a difference of refractive indices between another one of said plurality of light-transmitting films and the light-incoming side medium at a position x , and C is a constant.

5. (Previously Presented) The solid-state imaging apparatus according to claim 9, wherein heights of said plurality of light-transmitting films are constant in a direction normal to said plurality of light-transmitting films.
6. (Previously Presented) The solid-state imaging apparatus according to claim 9, wherein each of said plurality of light-transmitting films includes one of TiO_2 , ZrO_2 , Nb_2O_5 , Ta_2O_5 , Si_3N_4 and Si_2N_3 .
7. (Previously Presented) The solid-state imaging apparatus according to claim 9, wherein each of said plurality of light-transmitting films includes one of SiO_2 doped with B or P, that is Boro-Phospho Silicated Glass, and Teraethoxy Silane.
8. (Previously Presented) The solid-state imaging apparatus according to claim 9, wherein each of said plurality of light-transmitting films includes one of benzocyclobutene, polymethymethacrylate, polyamide and polyimide.
9. (Previously Presented) A solid-state imaging apparatus comprising arranged unit pixels, each of which includes a light-collector and a light-receiver, wherein said light-collector comprises:

a substrate into which incident light is incident; and

above said substrate, a plurality of light-transmitting films are formed in a region into which the incident light is incident,

wherein each light-transmitting film of said plurality of light-transmitting films forms a zone having a width which is equal to or shorter than a wavelength of the incident light,

wherein each zone shares a center point which is located at a position displaced from a center of said light-receiver, and

said plurality of light-transmitting films form an effective refractive index distribution represented by a quadratic curve expressed by a distance from a center of a corresponding one of the unit pixels,

wherein, in a unit pixel, among said unit pixels, which is located at a center of a plane on which said unit pixels are formed, a position at which an effective refractive index distribution of a corresponding light-collector represented by the quadratic curve reaches a maximum value matches a central axis of a corresponding light-receiver, and

wherein in a unit pixel, among said unit pixels, which is located at a periphery of the plane, a position at which the effective refractive index distribution of a corresponding light-collector represented by the quadratic curve reaches a maximum value is displaced from the central axis of a corresponding light-receiver toward the center of the plane.

10. (Previously Presented) The solid-state imaging apparatus according to claim 9,

wherein an off-centered light-transmitting film is formed in an area shared by one light-collector and another light-collector in an adjacent unit pixel.

11. (Previously Presented) The solid-state imaging apparatus according to claim 9, comprising:

a first unit pixel for a first color light out of the incident light; and

a second unit pixel for a second color light which has a typical wavelength that is different from a typical wavelength of the first color light;

wherein said first unit pixel includes a first light-collector , and

said second unit pixel includes a second light-collector, in which a focal length of the second color light is equal to a focal length of the first color light in said first light-collector .

12. (Previously Presented) The solid-state imaging apparatus according to claim 9, wherein a focal point is set at a predetermined position by controlling an effective refractive index distribution of said light-transmitting film.

13. (Previously Presented) The solid-state imaging apparatus according to claim 9, wherein each of said unit pixels further includes a light-collecting lens on a light-outgoing side of said light-collector .

14. (Previously Presented) The solid-state imaging apparatus according to claim 9, wherein an effective refractive index distribution of said light-transmitting film is different between light-collectors of said unit pixels located at the center of said plane on which said unit pixels are formed and light-collectors of said unit pixels located at the periphery of the plane.

15. (Cancelled).

16. (Previously Presented) The solid-state imaging apparatus according to claim 9,
wherein each of said plurality of light-transmitting films of one of said unit pixels
located near the center of an imaging area has a line width different from a line width of each of
said light-transmitting films of one of said unit pixels located at the periphery of the imaging
area and is located at a same relative position in said light-collector as a position of each of said
light-transmitting films of the one of said unit pixels located near the center of the imaging area,
the imaging area being a plane area on which said unit pixels are formed, and

a sum of line widths of said plurality of light-transmitting films of the one of said unit
pixels located near the center of the imaging area differs from a sum of line widths of said
plurality of light-transmitting films of the one of said unit pixels located at the periphery of the
imaging area.

17. (Previously Presented) The solid-state imaging apparatus according to claim 16,
wherein each of said plurality of light-transmitting films of the one of said unit pixels
located at the periphery of the imaging area has a line width shorter than a line width of each of
said light-transmitting films of the one of said unit pixels located near the center of the imaging
area and is located at a same relative position in said light-collector as a position of each of said
light-transmitting films of the one of said unit pixels located at the periphery of the imaging
area.

18. (Previously Presented) The solid-state imaging apparatus according to claim 9,

wherein each of said plurality of light-transmitting films of one of said unit pixels located at the periphery of an imaging area has a line width shorter than a line width of each of said light-transmitting films of one of said unit pixels located near the center of the imaging area and is located at a same relative position in said light-collector as a position of each of said light-transmitting films of the one of said unit pixels located at the periphery of the imaging area, the imaging area being a plane area on which said unit pixels are formed.

19. (Canceled).

20. (Previously Presented) The solid-state imaging apparatus according to claim 9, wherein said light-collector comprises a concentric ring structure including a plurality of divided areas, each formed of a pair of a high refractive index material zone and a low refractive index material zone, and

wherein in each of said unit pixels,

a predetermined divided area of the plurality of divided areas has a width that is a same as a width of a concentrically outer divided area, and

a width of the high refractive index material zone of the predetermined divided area is wider than a width of the high refractive index material zone of the concentrically outer divided area.

21. (New) A solid-state imaging apparatus comprising arranged unit pixels, each of which includes a light-collector and a light-receiver,

wherein said light-collector comprises:

a substrate into which incident light is incident; and

above said substrate, a plurality of light-transmitting films are formed in a region into which the incident light is incident,

wherein each light-transmitting film of said plurality of light-transmitting films forms a zone having a width which is equal to or shorter than a wavelength of the incident light,

wherein each zone shares a center point which is located at a position displaced from a center of said light-receiver, and

said plurality of light-transmitting films form an effective refractive index distribution,

wherein, in a unit pixel, among said unit pixels, which is located at a center of a plane on which said unit pixels are formed, a position at which an effective refractive index distribution of a corresponding light-collector reaches a maximum value matches a central axis of a corresponding light-receiver,

wherein in a unit pixel, among said unit pixels, which is located at a periphery of the plane, a position at which the effective refractive distribution of a corresponding light-collector reaches a maximum value is displaced from the central axis of a corresponding light-receiver toward the center of the plane,

wherein said light-collector comprises a concentric ring structure including a plurality of divided areas, each formed of a pair of a high refractive index material zone and a low refractive index material zone, and

wherein in each of said unit pixels,

a predetermined divided area of the plurality of divided areas has a width that is the same as a width of a concentrically outer divided area, and

a width of the high refractive index material zone of the predetermined divided area is wider than a width of the high refractive index material zone of the concentrically outer divided area.